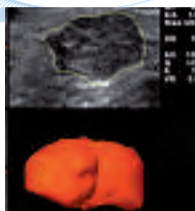




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Ovarian Follicle Assessment Using SonoAVC™

Breakthroughs in Ultrasonography

The objective, non-invasive appraisal of ovarian follicular status using ultrasound scans is an invaluable parameter for understanding normal and pathological ovarian function. In assisted reproductive technologies (ART), it is undoubtedly the key element for determining follicle maturation and readiness for triggering ovulation. When performed on a routine basis, this status appraisal has long been restricted to the 2D, manual determination of follicle diameters because, in the past, follicle volume assessment had been unreliable, complex and time-consuming. Moreover, given that ovarian follicles often display intricate shapes which depart from the ideal sphere or ellipsoid, the manual determination of diameters only provides a pale reflection of true follicle volume - a phenomenon which can

potentially misguide medical decisions. Another important clinical application for ovarian ultrasound scans in ART is the direct visualization and counting of small antral follicles. In combination with hormonal measurements, an antral follicle count using ultrasound scans has become an invaluable parameter in appraising ovarian follicle reserves. Yet exhaustive counting of such tiny ovarian structures (<7 mm) is often difficult and time intensive. During the last decade, multiple refinements in transvaginal ultrasound transducers and signal-treatment software - in particular the development of Virtual Organ Computer-aided Analysis (VOCAL™) technology - has greatly improved both the accuracy and user-friendliness of 3D reconstructions of ovarian ultrasonographic images, there-

by permitting the volumetric study of ovarian follicles. Indeed, data gathered so far even indicates that VOCAL™-assisted assessment of follicle volume provides more reliable results than those obtained from the geometric extrapolation of 2D diameters. However, in order to determine follicle volume, and because of the often irregular shape of these anatomical structures, VOCAL™ technology requires that the inner follicle borders are outlined - a manual process that needs to be repeated 6 to 30 times (for every 30°, 15°, 9° or 6° angle of rotation) making the procedure time-consuming and operator-dependent. These constraints prevent the routine use of VOCAL™ technology during the monitoring of assisted reproductive treatments. In order to overcome these limitat-

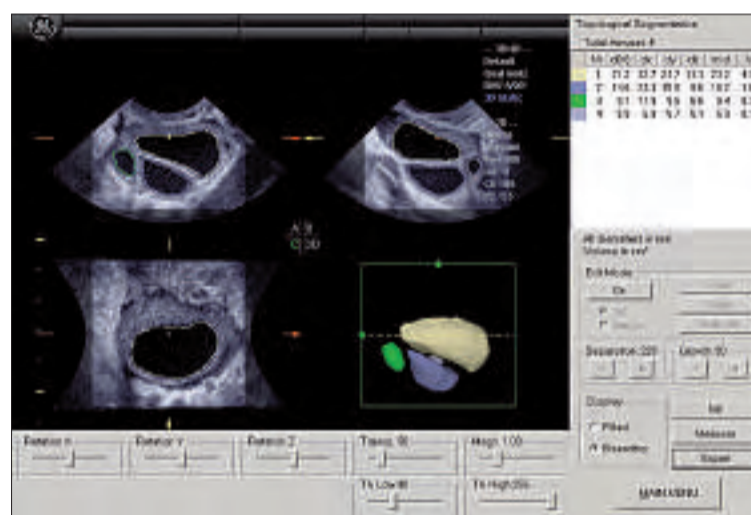
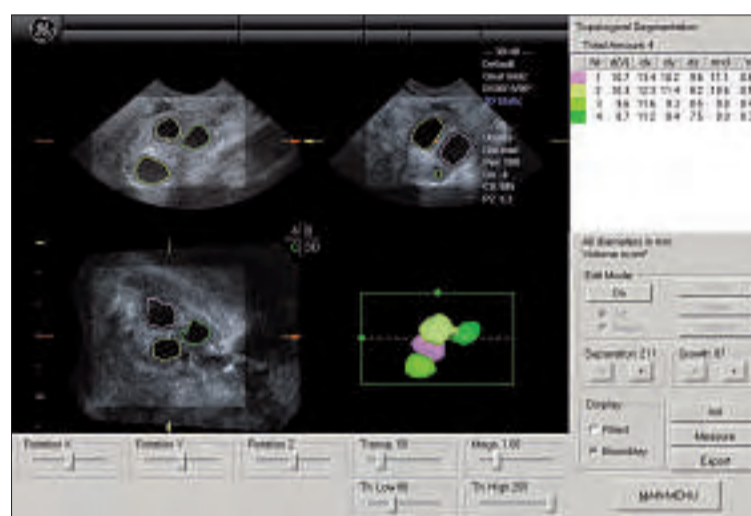


Figure: Automatic detection and measurement of ovarian follicles during ovarian stimulation. Note that, although follicles show intricate shapes, SonoAVC™ is able to provide precise diametric and volumetric information (upper right-hand corner).

EDITORIAL – Heinz GLOOR



Vice President /
General Manager
GE Healthcare
Technologies
Ultrasound & PCD
Europe, Middle
East & Africa

Dear Readers,

Those of you acquainted with the ways of the web will be familiar with the phrase "Content 2.0". This is essentially the technology which enables Internet users to move beyond the role of passive consumers and to interact with and contribute to the web pages they surf, creating "communities of interest". I see, and welcome, the parallels with "Content 2.0" in our own industry. You, your patients and all of us here at GE, together we

constitute our own community of interest. The goal of our community is to achieve a vision of "early health", to enable you, the clinician, to predict disease, save costs and greatly improve your patients' quality of life. Our innovative ideas, plus the feedback you provide from your patient work, all serve to stimulate the creative environment in which GE produces its breakthrough technological innovations in medical Ultrasound. This issue of GE Ultrasound Post focuses on the ways in which these innovations can open the doors to new applications for Ultrasound. We'll look at the avenues that DXA has opened up for pediatricians, the impact of Volume Imaging on breast care and the contribution of Tissue Harmonic Imaging to treating sports injuries.

Many of the benefits arising from our Ultrasound innovations are ancillary - but no less important. They include the cost savings, which result as disease is prevented or detected at an earlier stage, the efficiencies generated by greater standardization and structured reporting, and the diagnostic reassurance offered by multimodality IT.

I hope you enjoy this edition of GE Ultrasound Post and that it encourages you to continue playing an active role as a member of our visionary healthcare community.

Yours,

Heinz Gloor

ions, we became involved in developing an innovative approach, derived from topological segmentation technology, called Sonography-based Automated Volume Count, or SonoAVC™. This innovative module is an advance on VOCAL™ as it permits the automatic recognition of follicle borders, as well as 3D follicle reconstruction and follicle volume assessment (see figure) via a user-friendly interface. Our preliminary experiences with SonoAVC™ indicate that this system is fast and simple to use in assessing preovulatory follicle volume, and at least as reproducible and reliable as VOCAL™ when measurements are compared to the true follicular fluid volume - data which has recently been confirmed by

others. These promising results suggest that the simplicity and accuracy of SonoAVC™ will hopefully prompt clinicians to shift from 2D to 3D measurements in their daily assessment of volumetric, irregular structures such as ovarian follicles.

Finally, we are currently testing how SonoAVC™ can be used to identify and count small antral follicles, in an effort to render this important clinical parameter of ovarian reserve testing more reliable and operator-independent than conventional manual methodology.



Prof. Renato FANCHIN,
Head of Reproductive
Medicine at the Hospital
Antoine Bécclère
in Clamart, France

Ultrasound Solutions in Breast Care

Dr. Giorgio Rizzato is the Head of the Department of Diagnostic Imaging at the ASS 2 Isontina which includes the Gorizia and Monfalcone hospitals in north-eastern Italy. His department has full breast imaging expertise and uses a LOGIQ 9 as well as Full Field Digital Mammography (FFDM).

The breast team carries out an average of 30,000 breast exams each year and researches into ultrasound (US) contrast agents, breast Computer Assisted Densitometry (CAD) and preoperative staging.

Dr. Rizzato, your experience in breast care goes back decades. Which technological developments of the last 10 years do you consider to have made a major contribution to breast care?

Dr. RIZZATTO: We have seen many interesting developments in breast imaging but the major contribution has been the increasing resolution of US transducers and their capability to target very small lesions with very accurate biopsies. Specificity has increased, the need for surgical biopsies is declining, and preoperative staging is almost complete.

ion is early healthcare through prediction, diagnosis, treatment and monitoring. You are working with a GE Digital Mammography Senographe as well as a brand new LOGIQ 9. How do these technologies help you realize the GE Healthcare vision?

We started using the FFDM in April 2000 and it allows us to visualize anatomical structures which had been difficult to interpret using conventional mammography. As a result, we now need 40% fewer second level US examinations which means we can spend more time on improving diagnostic quality. Therefore the LOGIQ 9's high US resolution and 3D capabilities are a very effective support. My dream is to fuse the digital images from both pieces of equipment, so that we can puncture all the lesions which have suspicious findings with the aid of US.

You are now using the LOGIQ 9's Volume Imaging (VI) technology plus some additional features. What is VI's chief clinical value, and how does it boost the role of ultrasound in breast care?

Dr. RIZZATTO: It's quick and easy to acquire a volume. The resulting images have very good definition and we can trace the complex anatomy of the ducts and the ligaments. Moreover, we know that the images obtained along the coronal plane compare better with mammography. The TUI modality offers immediate multiple contiguous views of the lesion and its adjoining structures, allowing us to increase the specificity and better locate the pathology. Accurate volume assessment also helps us to monitor the lesions.

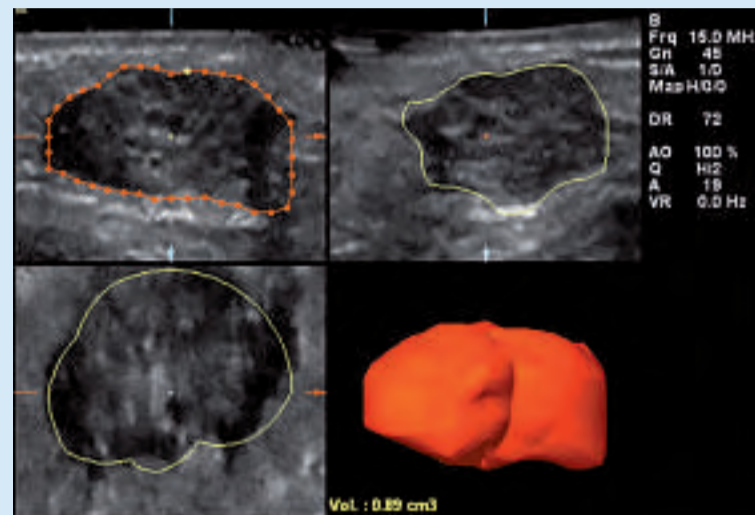
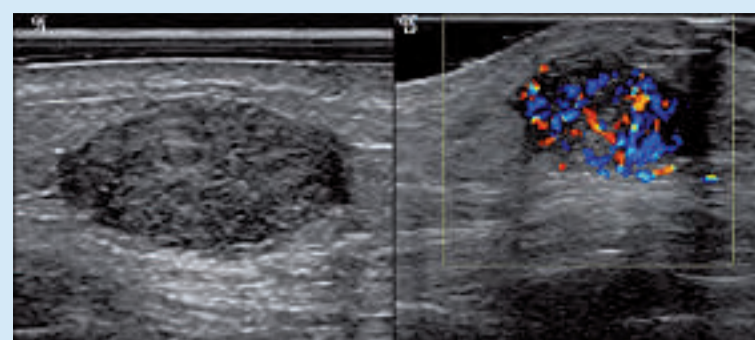
In your view, what are the benefits of sourcing both your mammography and US equipment from one organisation - GE?

Dr. RIZZATTO: In the past there was no reason for us to buy different instruments from the same company. However, today we live in a fully digitalised environment which means that our modalities can interact and be continually upgraded. Creating a strong partnership with a company such as GE is important for ensuring compliance and diagnosis quality - this is vital when you are responsible for a whole department with various targets and obligations. I would recommend partnering with a creative group such as GE which is a recognised innovation leader, not only in medical imaging.

What are the main challenges facing breast care?

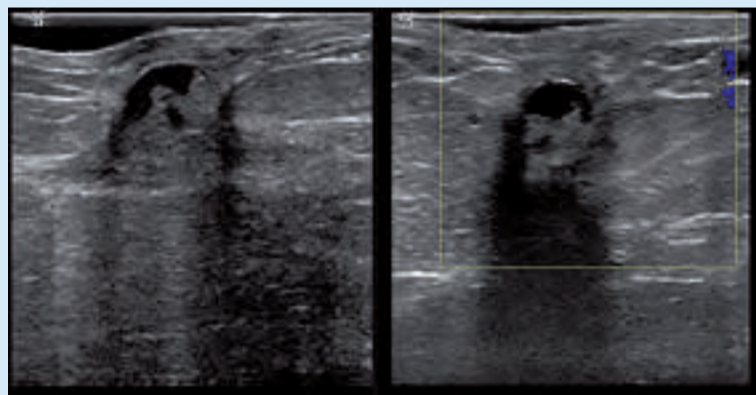
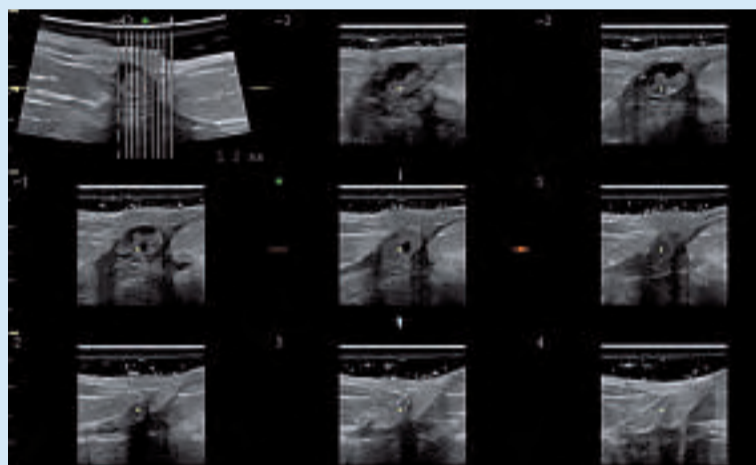
Dr. RIZZATTO: There are several: Finding the right way to introduce US and MRI into screening programs to increase detection of subclinical cancers whilst keeping costs manageable, monitoring the efficacy and effects of new anti-neoangiogenic therapies, and improving quality and reporting standards.

As you know, GE Healthcare's vis-



This 61 year old woman had biennial negative mammograms from 1987 to 2003. She is presenting four years later with a mobile palpable lump in the outer upper quadrant of the left breast.

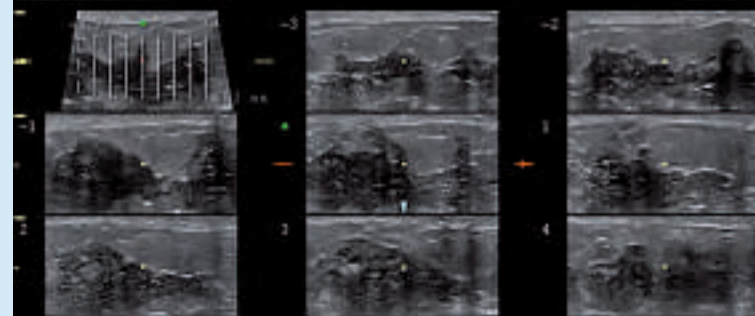
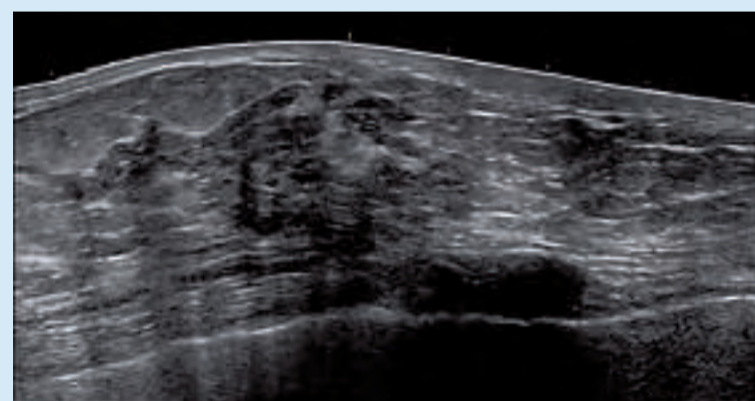
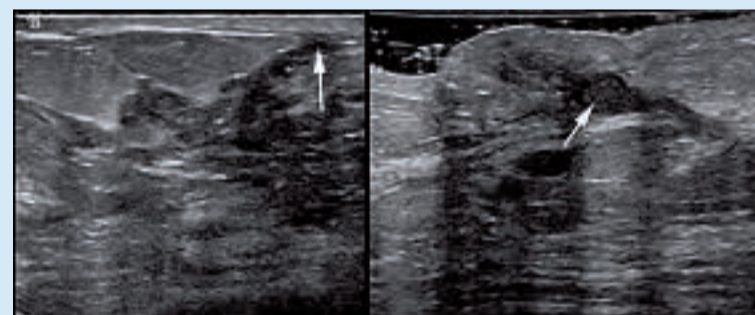
Mammography shows an oval opacity with a larger diameter of 14 mms. Margins are regular. There are no changes of Cooper's ligaments and subcutaneous fat. Sonography shows an homogeneous, solid mass. There are only signs of compression and the margins are regular also in the volumetric image. All the descriptors are in favour of a benign fibroadenoma. But there is a significant vascularity; vessels are irregular with different velocities. Also the clinical history is against a benign lesion. Core biopsy revealed a medullary carcinoma.



This 62 year old woman had conservative surgery in the inner upper quadrant of the left breast for sclerosing adenosis with lobular atypia simulating infiltrating carcinoma.

She has a mammography 2 years later because of a very hard nodule in the scar region. The left mammogram shows a suspicious spiculated opacity. The high contrast resolution of the digital technique identifies very small radiolucent areas within the lesion density. This sign along with the previous history may suggest the presence of fat necrosis, but an additional US examination is required.

Sonography shows a complex mass with a diameter of 9 mms. The absence of vascularity excludes a malignancy. TUI imaging after 3D volume acquisition makes the diagnosis more obvious; the lesion is clearly located within the scar and its margins are well defined. Most of the suspicious spiculations seen on mammography were due to only the fibrosis of the scar superimposed to the collections of oil and fat.



This 52 year old woman had no previous screening mammograms. She is presenting with a large palpable lump in the lower inner quadrant of the right breast. Mammography shows a large opacity with irregular margins and some microcalcifications. The oblique projection reveals thickening of the Cooper's ligaments and increased density of the subcutaneous fat.

Sonography has a highest definition in the superficial breast; it clearly confirms that the tumor has partially destroyed the superficial fascia and involves many ducts, even in the areola region (arrows).

The panoramic and TUI imaging clearly demonstrate that tumor involves almost all the inner quadrants up to the deeper breast and with a prevalent ductal distribution. But only MRI has the capability to define all the tumoral extent and the infiltration of the deep compartments close to the thoracic wall. Multiple core biopsies revealed several DCIS foci with extensive infiltration in the deeper portions. The patient is actually treated with preoperative chemotherapy for locally advanced breast cancer.

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New Vivid Family Members

GE Transforms Cardiovascular Ultrasound with the Vivid S6 and "Hybrid" Vivid S5

At this year's meeting of the American College of Cardiology (ACC) in Chicago in March, GE introduced its latest ultrasound system, the new "Hybrid" Vivid S5, a sibling to the signature class Vivid S6, which was launched late last year.

Both systems have been designed as dedicated cardiovascular solutions to meet the increasing demand for cardiac imaging at the point of care. Areas of application include the hospital and clinic, operating room and the physician's office. The Vivid S6 and Vivid S5 both boast a practical, easy to use design and state-of-the-art technology, again demonstrating GE's determination to re-invent and re-imagine the technology behind its success.

With the Vivid S6 and Vivid S5 GE has introduced a new concept and performance level for its ultrasound consoles. Both models leverage on GE Healthcare's miniaturization expertise gained from the compact Vivid *i*, the performance expertise of the console Vivid 7 and the proven utility and versatility of the Vivid 4. The new Vivid S6 and S5 cardiovascular ultrasound systems excel in terms of performance,

image quality and innovative design.

Their quantitative tools come directly from the acclaimed Vivid 7, including TVI and TSI. These proven clinical tools, plus stress echo and trans-esophageal echo capabilities, expand the reach of patient examinations. The signature class Vivid S6 also provides all the console benefits of a full sized 17 inch LCD monitor, four active transducer connectors and room for on-board peripherals, all in a miniaturized console weighing less than 70Kg. With its 15 inch monitor and three active transducer connectors, the Vivid S5 is the S6's younger sibling. Both new cardiovascular ultrasound systems feature backward data compatibility with the rest of GE Healthcare's Vivid family, including the Vivid 3 and Vivid 4. With enhanced connectivity and productivity tools and their new ergonomic design, the Vivid S6 and Vivid S5 are a great fit for routine cardiovascular and shared service ultrasound exams.

"The mobile design of these models meets modern demands and is very practical, especially where lab space is limited," says Dr. Wolfgang Fehske, Internist and Cardiologist

at St. Vinzenz Hospital in Cologne, Germany. "Another very exciting feature is the 100% fit with other Vivid family models in terms of keyboard operation and EchoPAC functionality, enabling the creation of an overall GE echo lab environment," he adds.

The all-new systems are also loaded with ergonomically friendly features, especially designed for portable studies. The "Flex-Fit" mechanism enables continuous pivoting height adjustment of the control panel, while keeping an optimal distance from the user and leaving just the right legroom for standing or sitting positions. The horizontal keyboard swivel ensures ideal placement and comfort during operation. A "Flex Key," positioned next to the trackball, can be assigned to assume the function of other, more distant keys, minimizing effort and increasing speed and ease of use. The high contrast, wide-angle display monitor includes an auto sensor which automatically adjusts brightness, contrast and gamma levels according to environmental lighting conditions, ensuring minimal eyestrain. "At GE Healthcare we continue to evolve and enhance the complete



Vivid product line," explains Anders Wold, General Manager of GE's cardiovascular ultrasound business. "Each innovation moves us closer to our vision of 'early health',

where clinicians can predict disease, save costs and greatly improve the patient's quality of life. That's healthcare re-imagined - and it's here, today".

Sports Traumatologist Prof. Jiménez-Díaz Explains the Advantages of Compact U/S

LOGIQ *e*: Compact U/S for Diagnosing Sports Injuries

Which medical device has most changed your daily practice as a sports traumatologist?

During my years as a specialist in sports medicine I have been primarily employed on the track where I work with athletes both to solve their pathological problems and to shorten sports injury recovery times. By helping to precisely locate and diagnose injuries, and to quickly determine the best forms of treatment, I would say that it is definitely ultrasound that has changed my daily practice most significantly.

What made you start using compact U/S?

The nature of sport - and especially professional sport - means that I need to work in a variety of differ-

ent locations. I might need to carry out an examination in a locker room one day and in a hotel room or on the track the next, so my medical equipment must be easily portable. You could say that compact ultrasound is the orthopedic practitioner's stethoscope!

Why did you choose a compact U/S device from GE?

Because GE's compact sonography devices incorporate innovative new technologies which greatly improve the visualization of damaged soft tissues. One important new technology is Tissue Harmonic Imaging (THI) which greatly improves the quality of the images of muscles, tendons and ligaments. Another application which improves soft tissue visualization is

the extended field-of-view technique giving a panoramic view of the tissues - very useful for large lesions such as those affecting the extensor apparatus of the knee or other muscles groups.

Another technical innovation I value in the GE compact U/S device is realtime compound ultrasound - a compound image produced by transmitting the ultrasound beams from various angles, thus increasing the lateral resolution of the image. GE's latest compact devices also include 3D images, enabling a transverse sweep which accumulates successive images to form a cube or volume composed of ultrasound images. And finally, it also has a virtual convex system.

Are there any specific applicati-

ons or injuries where you particularly like to use your compact U/S device?

We recently published a study on technological advances in musculoskeletal ultrasound examinations of sports injuries in which we examined a variety of injuries using a LOGIQ *e*. We observed that in muscle lesions resulting from contusion, not only is the edematous area better visualized but definition of the borders of the hemorrhagic areas and their content is especially increased. In muscle lesions resulting from distraction, the visualization time is prolonged, with persistence of hypo-echogenicity in the damaged area and maintenance of the hypervascularization.

In lesions of the tendons, the new

system affords better definition of the borders of the hypoechoic area of tendinous degeneration and perfect visualization of the extension of the damaged areas using a panoramic study. The 3D system allows a very precise definition of the extent of invasion of calcium deposits in the surrounding tendinous fibers.

What do you expect from the next generation of compact U/S devices?

We would like to be able to explore tissues such as the menisci or some shoulder ligaments which are currently not visible. The next generation of compact U/S devices should also incorporate transducers and systems to enable various surgical application.



Dr. Fernando JIMÉNEZ-DÍAZ,
Professor for Sports Traumatology at the Sports Science Facility, Castilla la Mancha University, Toledo, Spain

Dr. N.J. Crabtree's Vision for the Application of DXA in Pediatrics

Using DXA to Assess Metabolic Bone Health

Senile osteoporosis is well recognized as a pediatric disease and in our aging population the factors important for developing optimal bone strength during childhood are increasingly significant. Whilst basic skeleton morphology is genetically determined, the ability to reach genetic potential is only possible where environmental factors are favorable.

Twin studies have suggested that up to 40% of skeletal mass and/or strength can be modified by adaptive mechanisms which

straightforward, using DXA on children requires recognition that children cannot be considered simply to be small adults. Fortunately, with dedicated age & size specific protocols, accurate scan acquisitions and image analyses of children are now more easily achievable (Figure 1). However, the most significant challenge for pediatric DXA remains the

nation of poor nutrition, reduced physical activity, inflammatory cytokines and/or drugs may adversely affect skeletal growth and maturation (Figure 2).

In order to reduce any diagnostic ambiguity resulting from variations in body stature rather than genuine deficiencies in bone mass, reference values for bone mineral density in children should, ideally, either be independent of bone size when presented according to age or, alternatively, account for variations in both bone and body size (Fewtrell 2003). Several size-related interpretation algorithms are now available to assist in understanding DXA output such as the allometric (scaling) algorithm relating body height to age, bone area to height and bone mass to bone area (Molgaard 1999), and the functional algorithm relating muscle mass to height and bone mass to muscle mass (Frost 1987, Crabtree 2004) (Figures 3a-d).

The potential benefit of exploring the relationships between bone mass, bone size and body composition is that, where a deficit in bone mass is identified, the algorithms may potentially provide an insight into the etiology of the detected bone mass reduction. This insight may then reveal potential path-ways for intervention and thus prevention of osteoporosis and fragility fractures in childhood and later adult life.

From birth through to maturity the skeleton's bones continually change their shape, size and spatial distribution in response to genetic and environmental influences to optimize their strength to prepare for adulthood. The effect of genetics and modifiable factors, such as diet and exercise, varies according to bone type and the time of their onset. The many reasons for measuring bone strength in childhood may be broadly grouped as follows:

- To assess the impact of chronic disease in childhood
 - To monitor the effect of modifiable factors in healthy, growing children
 - To predict the current and future risk of fragility fractures
- The DXA technique is widely available, minimally invasive, low cost and readily accessible and can be safely performed on both healthy and sick children with minimal exposure to radiation.

Furthermore, both bone density and bone mass have been shown to relate to bone strength and fracture risk in childhood and maturity (Marshall 1996, Clark 2006). Consequently, where appropriate consideration is given to bone



Figure 1: The growing skeleton requires size specific acquisition and analysis protocols.

are sensitive to mechanical forces, nutrition and disease. Understanding and being able to assess the factors important in bone growth and development during childhood is essential when monitoring the acquisition of bone strength as it is believed that, once growth has

interpretation of bone densitometry results. The main factor causing confusion is that bone mineral density, as measured by DXA, is highly dependent on bone and body size - the larger the bone, the greater the estimate of areal bone density, regardless of the bone's true volumetric density (Prentice 1993).

This can prove problematic in children since, at any

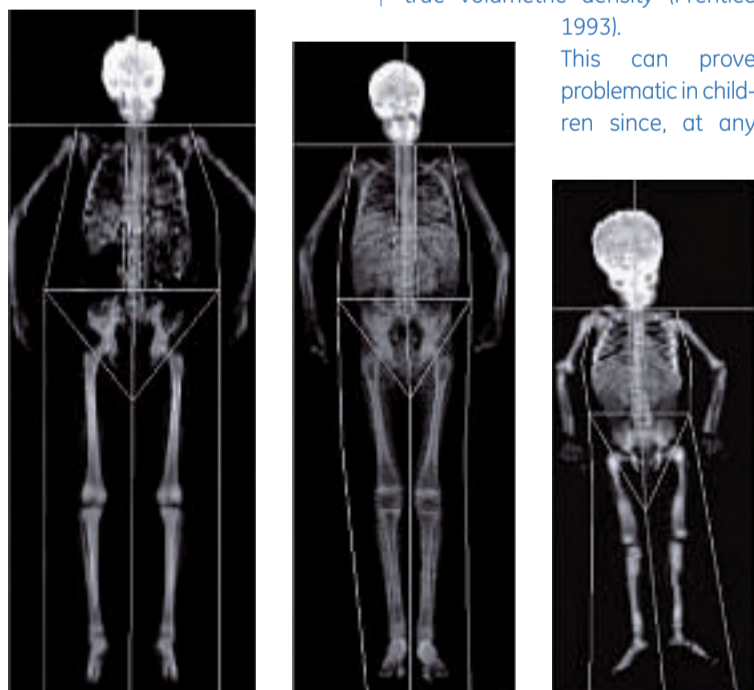


Figure 2: Illustrates three children of the same chronologic age, highlighting the varied effect of chronic disease on bone growth and development.

ceased, the skeleton can no longer be strengthened (Parfitt 1994). The current gold standard technique for assessing bone health in adults and children is dual energy X-ray absorptiometry (DXA). Whereas using DXA on adults is relatively

age, children will present a wide range of body, and hence bone, sizes as a result of variations in growth and/or maturity. Moreover, this issue of size is further exacerbated in children with chronic disease where a combi-

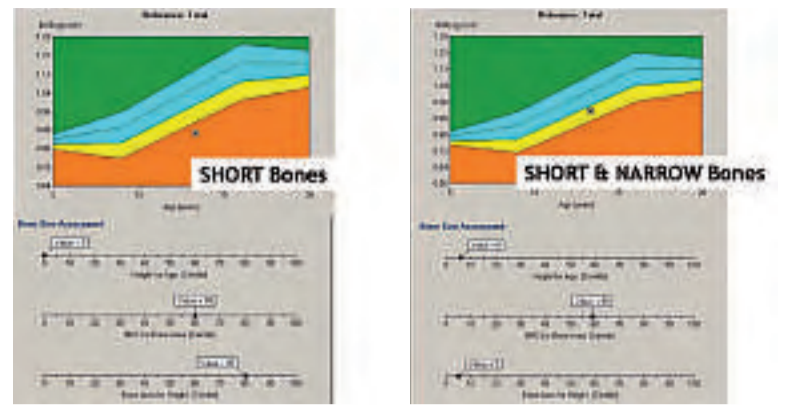


Figure 3a & b: Illustrates how the "Molgaard" approach can be used to explain the bone density output. (A) Is a child with Thalassemia who has greatly reduced stature but adequate bone size and mass for their stature & (B) Is a child with anorexia nervosa who has short stature and reduced bone size ("narrow bones") but adequate bone mass for their small skeleton.

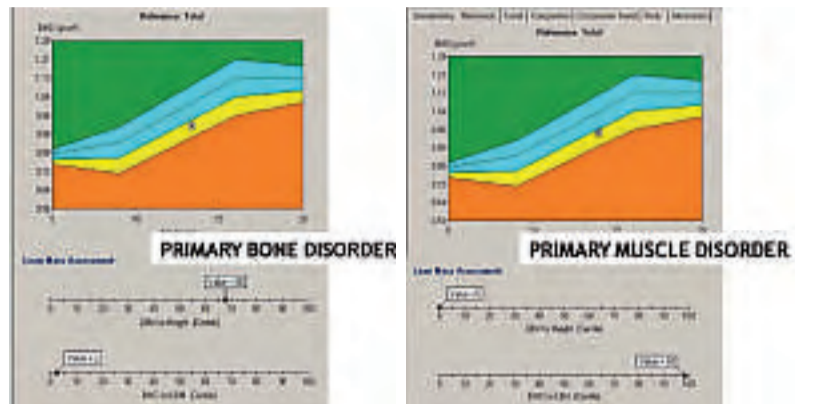


Figure 3c & d: Illustrates how the "Functional" approach can be used to explain the bone density output. (C) Is a child with mild Osteogenesis Imperfecta who has adequate muscle for their height but reduced bone mass for muscle mass, (D) Is a child with Duchenne muscular dystrophy who has reduced muscle mass for their height but adequate bone mass for their muscle mass.

and body size, DXA has a potentially useful role in the pediatric clinical and research environments.
Dr. N.J. CRABTREE

Currently employed as Principal Clinical Scientist at Birmingham Children's Hospital and Honorary Research Fellow at the University of Birmingham, UK, Nicola Crabtree is one of Europe's leading research clinical scientists in the field of Child Bone Health. GE Healthcare is very proud to welcome Dr. Crabtree, who has been using LUNAR DXA for nearly 15 years in pediatric studies and clinical practice, to Ultrasound Post with this concise account of the role of DXA in child disease, growth and development.

Peter DEMAN, Clinical Marketing Manager, EMEA
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